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DEVELOPMENT OF ENVIRONMENTAL SUPPORT ON MINE DETECTION
TECHNIQUES(U) BATTELLE-INSTITUT E V FRANKFURT AM MAIN
(GERMANY F R) P JESSL ET AL. JUL 83 DAJA45-82-C-0004

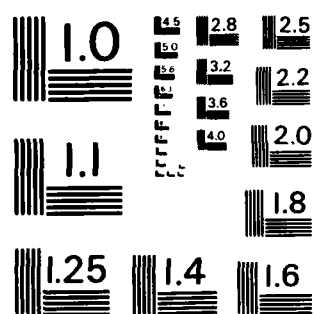
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Regarding Task 1 of the technical requirements - vegetation/crop and meteorological data - Terrain factor maps have been established for the following data:

- a) land-use (basic information)
- b) crop type
- c) crop/vegetation height
- d) crop/vegetation condition

A continuous flight line map at the scale 1:2.500 (600' flight height) plus single overlays (M=1:500, 300' flight height) were prepared in detail.

First, a general land-use mapping was made in order to delineate all areas exhibiting different characteristics from their neighbouring ones (i.e. varying colour, texture etc). This basic information process yielded maps a) and table 1. In a second step, crop types were established in such a way that various cultivating differences and cutting stages etc. were regarded very detailed. This yielded about 24 classes of crop types and is shown in map b) as crop type A as well as table 2. Later these 24 classes were lumped in such a way that for example cultivated areas such as harrowed or plowed fields are identified as one class only; also meadows and pastures were classed together including different cutting stages, too. Thus, the available data may be used from either of both maps produced, just depending on the degree of accuracy demanded. Crop type B map b) and table 3 show these second data sources.

Map c) shows the crop and vegetation heights of the flight line areas while table 4 identifies the height classes chosen. In addition to that classing, discrete heights of the areas mapped can be taken from table 1, where all basic characteristics are incorporated (basic land-use info No., crop type description, discrete crop/vegetation height, crop/vegetation condition).

Finally, map d) is depicting the crop and vegetation condition based on the proposed four class system in table 5.

Generally, the mapping procedures - including height assignments, crop condition assignments and crop type identification - are based on the following data and intellectual sources:

- several interviews with local farmers in the flight line areas of Darmstadt and Fulda as well as discussions with agricultural researchers
- field trips to the flight line and surrounding areas
- Growth heights, planting/harvesting dates and the general structure of the German agricultural areas (Tables 6-8)
- air photos provided by WES (300' and 600' flight heights)
- correlation of vegetation species, tree heights, stem diameters and site conditions
- meteorological data for the nearest weather stations Bad Hersfeld and Darmstadt

As the meteorological data and also interviews clearly indicate, 1982 had extremely dry summer conditions. Thus, all beef-raising crops (pastures, rape etc.) and also truck crops yielded poor results. Cereals however, yielded quite good crops. It was sometimes difficult to identify characteristic differences between beef-raising crops and meadows/pastures because of the extremely poor crop conditions of these areas (which resulted in untypical colours and textures).

Two additional maps have been provided at the 1:2.500 scale indicating both contours and numbers of the photos (600' height) making up the flight line areas.

Table 1: General Land-Use-Classification Describing Map (a) for the Darmstadt Area (including crop type A and B, height, and crop condition classes)

No.	General Land-Use/ Crop Type Description/ Height Estimates	Crop Type A Class	Crop Type B Class	Height Class	Crop Condi- tion Class
1	Field trail	24	006	00	0
2	Harrowed	02	001	00	0
3	Freshly harrowed	04	001	00	0
4	Green fodder (rape), H=65cm	15	003	03	1
5	Plowed	01	001	00	0
6	Harrowed	02	001	00	0
7	Freshly harrowed	04	001	00	0
8	Road ditch	24	006	00	0
9	Field trail, asphalt coated	24	006	00	0
10	Harrowed	02	001	00	0
11	Sugar-beets, H= 40 cm	06	007	02	1
12	Harrowed	02	001	00	0
13	Cult. Stubble field	20	001	00	0
14	Freshly harrowed	04	001	00	0
15	Field trail	24	006	00	0
16	Plowed	01	001	00	0
17	Field trail	24	006	00	0
18	Plowed	01	001	00	0
19	Cult. Stubble field	20	001	00	0
20	Cult. Stubble field (rotary hoe	20	001	00	0
21	Sugar-beets, H = 40 cm ^{cultiv.}	06	007	02	1
22	Turnips, H = 50 cm	08	008	02	1
23	Field trail	24	006	00	0
24	Freshly harrowed	04	001	00	0
25	Field trail, asphalt coated	24	006	00	0
26	Freshly harrowed	04	001	00	0
27	Harrowed	02	001	00	0
28	Freshly harrowed	04	001	00	0
29	Harrowed	02	001	00	0
30	Field trail	24	006	00	0
31	Freshly harrowed	04	001	00	0
32	Harvested potatoes	11	002	00	0
33	Potatoes, H = 40 cm	10	009	02	1
34	Harrowed	02	001	00	0
35	White cabbage	14	011	01	1
36	Freshly harrowed, H = 20cm	04	001	00	0

No.	General Land-Use/ Crop Type Description/ Height Estimates	Crop Type A Class	Crop Type B Class	Height Class	Crop Condi- tion Class
37	Field trail, asphalt coated	24	006	00	0
38	Harrowed	02	001	00	0
39	Field trail	24	006	00	0
40	Freshly plowed	03	001	00	0
41	Field trail	24	006	00	0
42	Ditch, scattered bushes	23	005	03	0
43	Sowed	05	001	00	0
44	Cultivated stubble field	20	001	00	0
45	Stubble field, H= 5 cm	19	002	01	0
46	Turnips, H = 50 cm	08	008	02	1
47	Sowed	05	001	00	0
48	Field trail, asphalt coated	24	006	00	0
49	Stubble field, H = 5 cm	19	002	01	0
50	Harrowed	02	001	00	0
51	Sowed	05	001	00	0
52	Plowed	01	001	00	0
53	Field trail	24	006	00	0
54	Field trail	24	006	00	0
55	Ditch, waterfilled	24	006	00	0
56	Corn field, H = 2 m	12	010	06	3
57	Stubble field, H = 5 cm	19	002	01	0
58	Piled straw, H = 2 m	24	006	06	0
59	Plowed	01	001	00	0
60	Harrowed	02	001	00	0
61	Field trail	24	006	00	0
62	Freshly plowed	03	001	00	0
63	Turnips, H = 50 cm	08	008	02	1
64	Harrowed	02	001	00	0
65	Idle land (flooded/spoilt turnips crop)	23	005	00	0
66	Ditch	24	006	00	0
67	Field trail, concrete coated	24	006	00	0
68	Field trail	24	006	00	0
69	Plowed	01	001	00	0
70	Meadow, H = 20 cm	17	003	01	1
71	Cut green fodder, H=5 cm	16	003	01	0
72	Green fodder (rape), H=65 cm	15	003	03	1

No.	General Land-Use/ Crop Type Description/ Height Estimates	Crop Type A Class	Crop Type B Class	Height Class	Crop Condi- tion Class
73	Turnips, H = 50 cm	08	008	02	1
74	Plowed	01	001	00	0
75	Stubble field, H = 5 cm	19	002	01	0
76	Ditch	24	006	00	0
77	Cultivated stubble field	20	001	00	0
78	Field trail	24	006	00	0
79	Meadow/Damslope, H= 20cm	17	003	01	1
80	Field trail	24	006	00	0
81	Sugar-beets, H = 30 cm	06	007	01	1
82	Green fodder (rape), H=65 cm	15	003	03	1
83	Cut green fodder, H= 5cm	16	003	01	0
84	Green fodder (rape), H=65 cm	15	003	03	1
85	Green fodder (rape), H=65 cm	15	003	03	1
86	Corn, H = 2 m	12	010	06	3
87	Corn, H = 2 m	12	010	06	3
88	Cut corn field, H = 10 cm	13	002	01	0
89	Meadow, H = 20 cm	17	003	01	1
90	Forested bushes, deciduous H=40'-50' (alder trees, willows)	22	004	40/50	2
91	Harrowed	02	001	00	0
92	Plowed	01	001	00	0
93	Corn, H = 2 m	12	010	06	3
94	Field trail	24	006	00	0
95	Green fodder (rape), H=65 cm	15	003	03	1
96	Harrowed	02	001	00	0
97	Ditch	24	006	00	0
98	Harrowed	02	001	00	0
99	Cut meadow, H = 5 cm	18	003	01	0
100	Plowed	01	001	00	0
101	Harrowed	02	001	00	0
102	Ditch, bushes/single trees	23	005	00	0
103	Field trail	24	006	00	0
104	Harrowed	02	001	00	0
105	Idle land, grass, H= 20 cm	23	003	01	0
106	Idle land, grass, H= 20 cm	23	003	01	0
107	Harrowed	02	001	00	0

No.	General Land-Use/ Crop Type Description/ Height Estimates	Crop Type A Class	Crop Type B Class	Height Class	Crop Condi- tion Class
108	Harrowed	02	001	00	0
109	Field trail	24	006	00	0
110	Sugar-beets, H = 30 cm	06	007	01	1
111	Sowed	05	001	00	0
112	Plowed	01	001	00	0
113	cult. stubble field, H=5cm	20	001	00	0
114	Stubble field, H = 5 cm	19	002	01	0
115	Meadow, H = 20 cm	17	003	01	1
116	Plowed	01	001	00	0
117	Field trail	24	006	00	0
118	Harrowed	02	001	00	0
119	Stubble field, cultivated	20	001	00	0
120	Plowed	01	001	00	0
121	Plowed	01	001	00	0
122	Harrowed	02	001	00	0
123	Harrowed	02	001	00	0
124	Sowed	05	001	00	0
125	Meadow, H = 45 cm	17	003	02	1
126	Stubble field, cultivated	20	001	00	0
127	Harvested potatoes	11	002	00	0
128	Sowed	05	001	00	0
129	Sowed	05	001	00	0
130	Plowed	01	001	00	0
131	Sugar-beets, H = 30 cm	06	007	01	1
132	Harrowed	02	001	00	0
133	Harrowed	02	001	00	0
134	Meadow, H = 20 cm	17	003	01	1
135	Idle land, grass/bushes H = 80 - 90cm	23	005	03	0
136	Forest, deciduous, ash trees H = 90 - 95'	22	004	90/95	3
137	Special area, clearing	24	006	00	0
138	Forest trail	24	006	00	0
139	Young deciduous forest stand, H = 6'	22	004	06	3
140	Young deciduous forest stand, H = 4'	22	004	04	3
141	Harrowed	02	001	00	0

Table 1: General Land-Use-Classification Describing Map (a) for the Fulda Area (including crop type A and B, height, and crop condition classes)

No.	General Land-Use/ Crop Type Description/ Height Estimates	Crop Type A Class	Crop Type B Class	Height Class	Crop Condi- tion Class
1	Harrowed	02	001	00	0
2	Field trail, asphalt coated	24	006	00	0
3	Freshly harrowed	04	001	00	0
4	Harrowed	02	001	00	0
5	Field trail, metalled	24	006	00	0
6	Freshly harrowed	04	001	00	0
7	Harrowed	02	001	00	0
8	Freshly harrowed	04	001	00	0
9	Potatoes, H = 35 cm	10	009	02	1
10	Turnips, H = 45 cm	08	008	02	1
11	Plowed	01	001	00	0
12	Freshly plowed	03	001	00	0
13	Corn, H = 150 cm	12	010	06	1
14	Cut green fodder (lucerne, lupine) H = 20 cm	16	003	01	0
15	Potatoes, H = 35 cm	10	009	02	1
16	Turnips, H = 45 cm	08	008	02	1
17	Corn stubble field, H=10cm	13	002	01	0
18	Corn, H > 150 cm	12	010	06	1
19	Freshly plowed	03	001	00	0
20	Harrowed	02	001	00	0
21	Potatoes, H = 35 cm	10	009	02	1
22	Turnips, H = 45 cm	08	008	02	1
23	Harrowed	02	001	00	0
24	Freshly harrowed	04	001	00	0
25	Field trail	24	006	00	0
26	Cult. Stubble field	20	001	00	0
27	Turnips, H = 45 cm	08	008	02	1
28	Stubble field	19	002	01	0
29	Cut meadow, 10 cm	18	003	01	0
30	Drainage ditch	24	006	00	0
31	Harrowed	02	001	00	0
32	Cut meadow, H = 10 cm	18	003	01	0
33	Meadow, H = 30 cm	17	003	01	1
34	Field trail, asphalt coated	24	006	00	0
35	Field trail, metalled	24	006	00	0

No.	General Land-Use/ Crop Type Description/ Height Estimates	Crop Type A Class	Crop Type B Class	Height Class	Crop Condi- tion Class
36	Sowed	05	001	00	0
37	Cut meadow, H = 10 cm	18	003	01	0
38	Cut meadow, H = 10 cm	18	003	01	0
39	Meadow, H = 30 cm	17	003	01	1
40	Harrowed	02	001	00	0
41	Idle land, grass, H=20cm	23	003	01	0
42	Field trail, metalled	24	006	00	0
43	Field trail	24	006	00	0
44	Harvested Potatoes	11	002	00	0
45	Cut meadow, H = 10 cm	18	003	01	0
46	Cut meadow, H = 10 cm	18	003	01	0
47	Sowed	05	001	00	0
48	Harrowed	02	001	00	0
49	Idle land, grass, H=20cm	23	003	01	0
50	Sowed	05	001	00	0
51	Harrowed	02	001	00	0
52	Stubble field, H = 5 cm	19	002	01	0
53	Harrowed	02	001	00	0
54	Potatoes, H = 35 cm	10	009	02	1
55	Harrowed	02	001	00	0
56	Stubble field, H = 5 cm	19	002	01	0
57	Field trail	24	006	00	0
58	Meadow, H = 25 cm	17	003	01	1
59	Stubble field with drai- nages, H = 5 cm	19	002	01	0
60	Harrowed	02	001	00	0
61	Forest, deciduous (oak 80%, beech 20%), H = 60 cm	22	004	60	2
62	Meadow, H = 15 cm	17	003	01	1
63	Field trail	24	006	00	0
64	Corn, H = 180 cm	12	010	06	2
65	Corn stubble field, H=10cm	13	002	01	0
66	Meadow, H = 15 cm	17	003	01	1
67	Ditch	23	005	00	0
68	Secondary road, asphalt coated	24	006	00	0
69	Plowed	01	001	00	0
70	Meadow, H = 15 cm	17	003	01	1

No.	General Land-Use/ Crop Type Description/ Height Estimates	Crop Type A Class	Crop Type B Class	Height Class	Crop Condi- tion Class
71	Cut green fodder, H=5 cm	16	003	01	0
72	Meadow, H = 35 cm	17	003	02	1
73	Stubble field, H = 5 cm	19	002	01	0
74	Freshly plowed	03	001	00	0
75	Field trail, metalled	24	006	00	0
76	Field trail, asphalt coated	24	006	00	0
77	Cut meadow, H = 5 cm	18	003	01	0
78	Former silo-area	24	006	00	0
79	Silo, H = 2 m	24	006	06	0
80	Meadow, H = 25 cm	17	003	01	1
81	Meadow, H = 25 cm	17	003	01	1
82	Cut Meadow, H = 5 cm	18	003	01	0
83	Stubble field, H = 5 cm	19	002	01	0
84	Idle land, grass, H=35 cm	23	003	02	0
85	Field trail with ditch	24	006	00	0
86	Cut meadow, H = 5 cm	18	003	01	0
87	Pasture, H = 20 cm	21	003	01	1
88	Railway dam slope, idle land, H = 20 cm	24	006	01	0
89	Pasture, H = 20 cm	21	003	01	1
90	Field trail	24	006	00	0
91	Cut meadow, H = 5 cm	18	003	01	0
92	Plowed	01	001	00	0
93	Meadow, H = 25 cm	17	003	01	1
94	Cut Meadow, H = 5 cm	18	003	01	0
95	Plowed	01	001	00	0
96	Stubble field, H = 5 cm	19	002	01	0
97	Harrowed	02	001	00	0
98	Field trail, metalled	24	006	00	0
99	Secondary road, asphalted	24	006	00	0
100	Coniferous forest stand, pines, H = 70'	22	004	70	1
101	Harrowed	02	001	00	0
102	Harrowed	02	001	00	0
103	Cut meadow, H = 5 cm	18	003	01	0
104	Harrowed	0	001	00	0
105	Turnips, H = 45 cm	08	008	02	1
106	Freshly harrowed	04	001	00	0

No.	General Land-Use/ Crop Type Description/ Height Estimates	Crop Type A Class	Crop Type B Class	Height Class	Crop Condi- tion Class
107	Freshly plowed	03	001	00	0
108	Corn, H = 180 cm	12	010	06	2
109	Harrowed	02	001	00	0
110	Field trail	24	006	00	0
111	Shed, scattered trees, H = 17'	24	006	17	0
112	Plowed	01	001	00	0
113	Harrowed	02	001	00	0
114	Harrowed, spotted animal fertilizer	02	001	00	0
115	Cut meadow, H = 5 cm	18	003	01	0
116	Pasture, spotted animal fertilizer, H = 25 cm	21	003	01	1
117	Forest, deciduous, alder- trees, H = 55'	22	004	55	2
118	Forest, coniferous, spruce, H = 75'	22	004	75	2
119	Field trail	24	006	00	0
120	Meadow, H = 30 cm	17	003	01	1
121	Meadow, H = 30 cm	17	003	01	1
122	Cut Meadow, H = 5 cm	18	003	01	0
123	Cut Meadow, H = 5 cm	18	003	01	0
124	Harrowed	02	001	00	0
125	Harrowed, fertilized	02	001	00	0
126	Potatoes, H = 35 cm	10	009	02	1
127	Harvested potatoes	11	002	00	0
128	Cabbage, H = 20 cm	14	011	01	1
129	Harrowed	02	001	00	0
130	Turnips, H = 45 cm	08	008	02	1
131	Harvested turnips	09	002	00	0
132	Harrowed	02	001	00	0
133	Field trail, metalled	24	006	00	0
134	Field trail	24	006	00	0
135	Harrowed	02	001	00	0
136	Harrowed	02	001	00	0
137	Stubble field, H = 5 cm	19	002	01	0
138	Harrowed	02	001	00	0
139	Cultivated stubble field	20	001	00	0
140	Cultivated stubble field	20	001	00	0
141	Forest, coniferous, pines H = 27'	22	004	27	2

Table 2: Crop Type A Classification Describing Map b)

Code No.	Crop Type
01	Plowed field
02	harrowed field
03	freshly plowed field
04	freshly harrowed field
05	sowed
06	sugar-beets
07	harvested sugar-beets
08	turnips
09	harvested turnips
10	potatoes
11	harvested potatoes
12	corn
13	harvested corn
14	white cabbage
15	green fodder (rape); beef-raising crop
16	cut green fodder (cut rape)
17	meadow
18	cut meadow
19	stubble field
20	cultivated stubble field
21	pasture
22	forest
23	idle land
24	special areas (trails, sheds etc.)

Table 3: Crop Type B Classification Describing Map b)

Code No.	Crop Type
001	freshly cultivated soils, cultivated stubble fields
002	harvested truck crops, stubble fields
003	meadows (incl. recently cut ones), pastures green fodder/rape (incl. recently cut ones)
004	forest
005	idle land
006	special areas
007	sugar beets
008	turnips
009	potatoes
010	corn
011	white cabbage

Table 4: Crop/Vegetation Height Describing Map c)

Code No.	Crop/Vegetation Height
00	no crop/vegetation
01	> 0 - 30 cm
02	> 30 - 60 cm
03	> 60 - 90 cm
04	> 90 - 120 cm
05	> 120 - 150 cm
06	> 150 cm

Table 5: Crop/Vegetation Condition Describing Map d)

Code No.	Crop/Vegetation Condition
0	no crop/vegetation
1	poor
2	normal
3	good

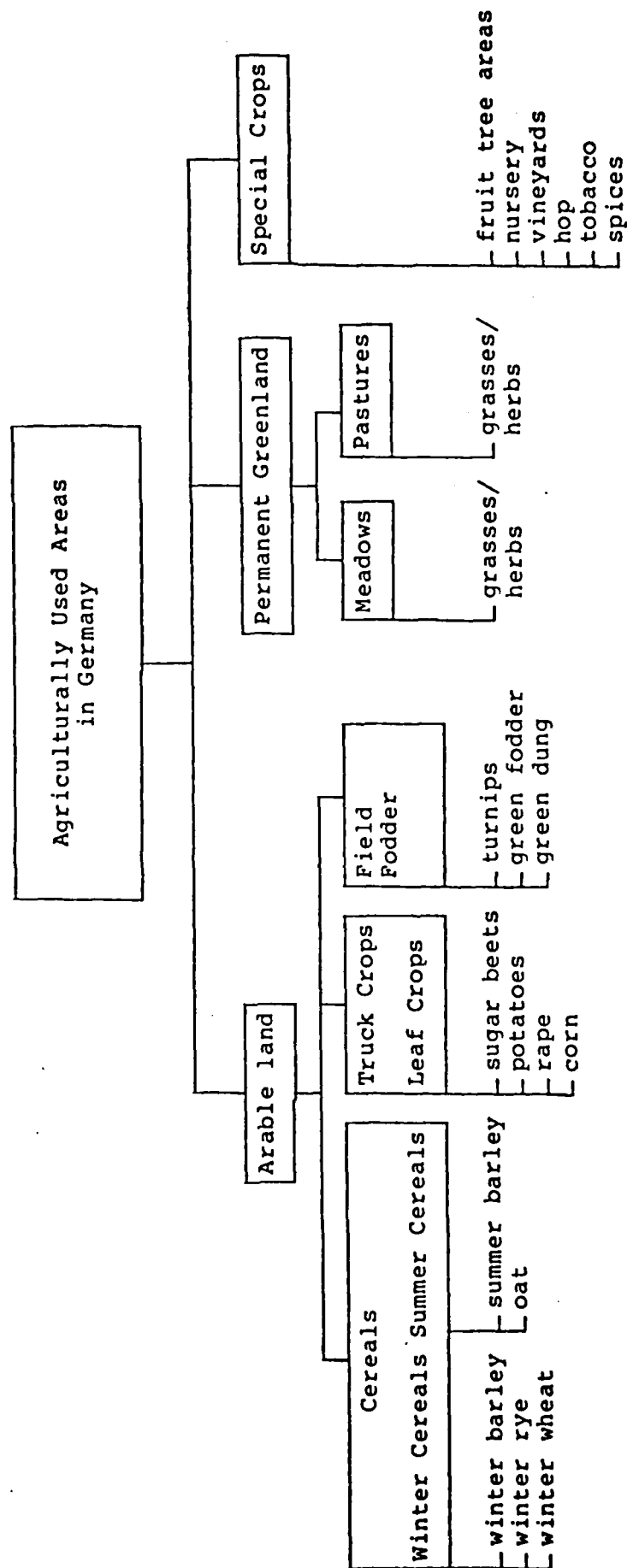
Table 6: Growth Heights of Most Important Plants in Germany

		G r o w t h H e i g h t (cm)											
		Jan.	Febr.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
cereals	winter barley	-	-	-	10-15	20-40	40-100	100	-	-	-	-	-
	winter rye	-	-	-	10-15	20-45	45-120	120	-	-	-	-	-
	winter wheat	-	-	-	10-15	20-40	40-100	100	100	-	-	-	-
	summer barley	-	-	-	10	20-40	40-90	90	90	-	-	-	-
	oat	-	-	-	10	20-40	40-90	90	90	-	-	-	-
truck crops	sugar beets	-	-	-	10	10-30	30-40	40	40	40	40	40	-
	potatoes	-	-	-	-	10	10-30	30-50	50	50	20-30	-	-
	rape	-	-	-	20	20-50	50-120	100	100	-	-	-	-
	corn	-	-	-	-	0-10	10-60	60-100	100-200	200	200	-	-
field fodder	turnips	-	-	-	10-15	15-50	50-60	60	60	60	-	-	-
	green fodder	-	-	-	-	-	-	-	0-10	10-30	20-30	20-30	-
	green dung	-	-	-	-	-	-	-	0-10	10-30	20-30	20-30	-
meadows, pastures	grasses	10	10	10	10	10-30	30-50	10-20	20-40	10	10	10	10
	herbs	10	10	10	10	10-30	30-50	10-20	20-40	10	10	10	10

Table 7: Planting and Harvesting Dates for the Most Important
Plants in Germany

p l a n t s		date of planting	date of harvesting
cereals	winter barley	September	July
	winter rye	October	August
	winter wheat	Oct./Nov.	August
	summer barley	Mar./April	August
	oat	Mar./April	August
truck crops	sugar beets	Mar./April	Sept./Dec.
	potatoes	April	July/October
	winter rape	August	July
	summer rape	April	August
	corn	April/May	October
field fodder	turnips	Mar./April	September
	green fodder	July/Aug.	Oct./Nov.
	green dung	July/Aug.	Oct./Dec.
meadows pastures	grasses	-	June + Aug.
	herbs	-	June + Aug.

Table 8: Structure of the Agriculturally Used Areas in Germany



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